

CLAIMS OF THE INVENTION

We claim:

1. Method for manufacturing complex shape parts including parts with cavities from powder materials by Hot Isostatic Pressing (HIP) with controlled pressure inside the HIP tooling and providing the shape of the part by multi-layer inserts comprising:
 - manufacturing of the shaping tool which includes a capsule having the internal shape and dimensions corresponding to the shape and dimensions of the final part;
 - manufacturing of the inserts including hollow inserts to provide the shape and dimensions of the cavities in the part;
 - assembling of the said capsule with inserts;
 - filling the said capsule with powder material;
 - HIP of capsule with powder;
 - control of pressure inside the HIP tooling;
 - removal of the capsule and inserts;
2. A method in accordance with the claim 1 wherein the said capsule is manufactured as a can with hollow or solid inserts.
3. A method in accordance with the claim 2, wherein the said inserts are made multi-layered.

4. A method in accordance with the claim 3, wherein the thickness of each layer of the multi-layer inserts is $1/10 - 1/20$ of the total height of the said can.
5. A method in accordance with the claim 3, wherein the thickness of each layer is determined to minimize machining and material expenses.
6. A method in accordance with the claim 1 providing the controlled pressure inside the HIP tooling comprising the steps of:
 - manufacturing of the HIP tooling element controlling the pressure inside hollow inserts;
 - providing a vent tube connection to the component part controlling the pressure inside hollow inserts;
 - assembling of the said capsule with inserts;
 - filling the said capsule containing inserts with powder;
 - application of Hot Isostatic Pressure to the said capsule with powder;
 - injection of the HIP gas media into the cavity of the said insert;
 - removal of the hollow inserts by acid pickling;
7. A method in accordance with the claim 6, wherein controlled pressure inside the HIP tooling is provided by installing inside the vent tube of a component part with the melting temperature below the final HIP temperature;
8. A method in accordance with the claim 6, wherein controlled pressure inside the HIP tooling is provided by installing inside the vent tube of a membrane;

9. A method in accordance with the claim 8, wherein a said membrane has a collapse pressure below the final HIP pressure;
10. A method in accordance with the claim 6, wherein controlled pressure inside the HIP tooling is provided in three steps:
- during the first step the said capsule filled with powder and comprising hollow inserts not connected to the atmosphere is HIPed below the final HIP temperature so that the pressure on the outer surface of the hollow inserts exceeds the current HIP pressure;
 - during the second step the said capsule is cooled and the cavity of the insert is connected to the atmosphere;
 - during the third step the said capsule is HIPed to the final HIP temperature providing the HIP pressure inside the hollow inserts by injecting the HIP gas media into the cavity of the said inserts;
11. System of manufacturing complex shape parts including parts with cavities from powder materials by Hot Isostatic Pressing (HIP) with controlled pressure inside the HIP tooling and providing the shape of the part by multi-layer inserts comprising:
- the shaping tool which includes a capsule having the internal shape and dimensions corresponding to the shape and dimensions of the final part;
 - multi-layer inserts including hollow inserts providing the shape and dimensions of the cavities in the part;
 - powder material;
 - HIP tooling element controlling the pressure inside said hollow inserts comprising a vent tube;

12. A system in accordance with the claim 11, wherein the said HIP tooling element controlling the pressure inside hollow inserts is made as a membrane with a collapse pressure below the final HIP pressure.
13. A system in accordance with the claim 11, wherein the said HIP tooling element controlling the pressure inside hollow inserts has a melting temperature below the final HIP temperature.
14. Method for manufacturing complex shape parts including parts with cavities from powder materials by Hot Isostatic Pressing (HIP) with subsequent simultaneous removal of the outer capsule and inserts by acid pickling provided by the hollow inserts connected to the atmosphere.